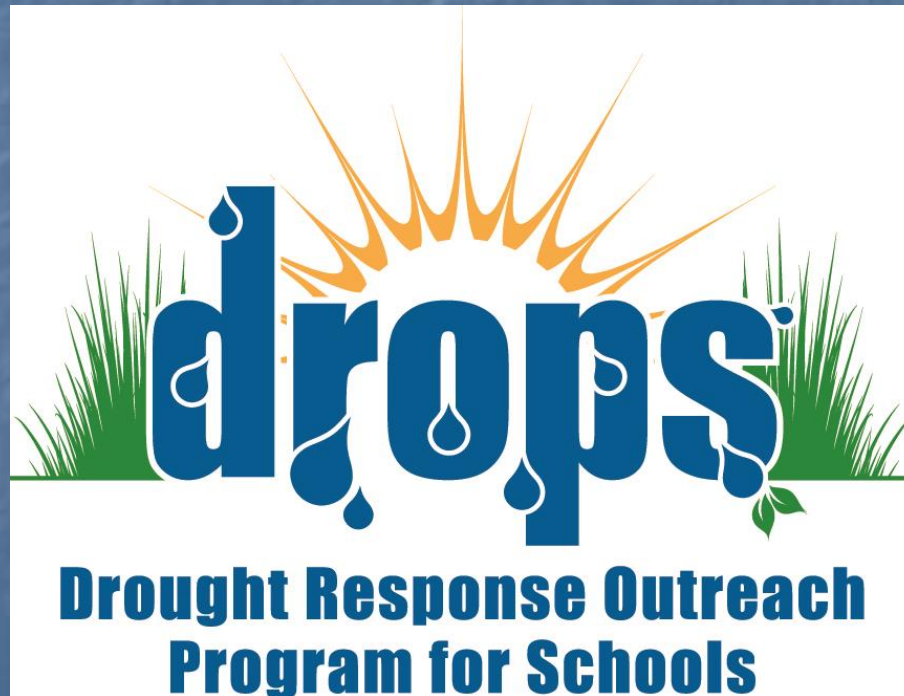


# **Drought Response Outreach Program for Schools (DROPS)**

## **Technical Assistance Support**



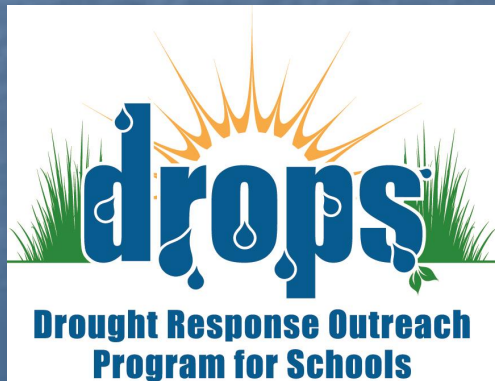
**Friday, November 14, 2014**

# Presentation Outline

- Low Impact Development (LID)
- Project feasibility
- Sizing your LID project
- Estimating project costs
- Estimating water quality benefits

# Module 1:

## LID and Project Feasibility





# Low Impact Development

- LID designs mimic how rainwater would naturally interact with the landscape (slow, spread, sink).



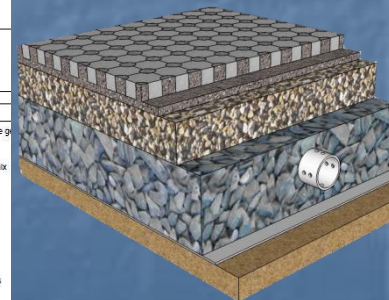
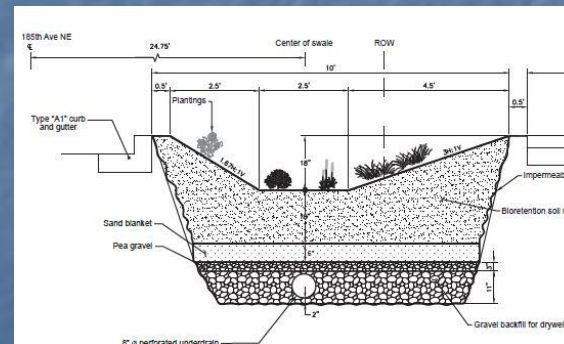


# Low Impact Development

- LID designs are intended to reduce stormwater runoff volumes and pollutants.
- The surface of a LID feature may not look like anything special, but underneath, they are designed to work hard!



Morton Arboretum, Illinois



# Project Feasibility

- Understand how stormwater is currently managed. Often the existing system provides an opportunity to intervene with a LID design.
- Consider whether the project is compatible with current uses and features.



# Project Feasibility

- Getting stormwater to your project
  - Are there locations where stormwater runoff can be intercepted to slow, infiltrate and/or treat?



Parking Lots



Figure 33. Pervious Paver Parking Stalls, Redlands, CA.  
Source: Jeff Endicott

# Project Feasibility

- Getting stormwater to your project
  - Are there locations where stormwater runoff can be intercepted to slow, infiltrate and/or treat?



Buildings



# Project Feasibility

- Can excess stormwater exit via a curb cut, overflow or underdrain?



Curb Cut



Sheet Flow



# Project Feasibility

- Can excess stormwater exit via a curb cut, overflow or underdrain?



Flush Channel



Open Channel



# Project Feasibility

- Can excess stormwater exit via a curb cut, overflow or underdrain?



Trench Drains

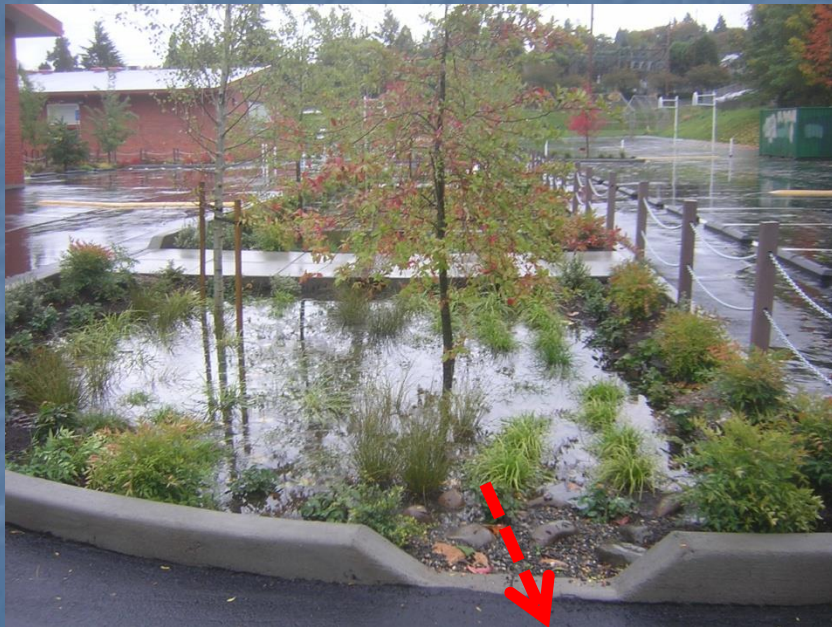


Fun!!



# Project Feasibility

- Can excess stormwater exit via a curb cut, overflow or underdrain?



Curb Cut



Overland Sheet Flow



# Project Feasibility

- Can excess stormwater exit via a curb cut, overflow or underdrain?



Existing Exterior Overflow Inlet



Existing Interior Overflow Inlet



# Project Feasibility

- Can excess stormwater exit via a curb cut, overflow or underdrain?



Overflow Drain Inlet



Underdrain System



# Project Feasibility

- For disconnection to be safe and effective, each downspout must discharge into a suitable receiving area. Runoff must not flow toward building foundations or cause flooding.



# Project Feasibility

- Consider existing uses and features
  - Can the existing function be altered?
  - Proximity to buildings, slopes, utilities



# Project Feasibility

- Can the existing function be altered?





# Project Feasibility

- Pedestrian considerations





# Project Feasibility

## ■ Proximity to buildings



Seaquam Secondary School Rain Garden  
<http://www.vcn.bc.ca/cougarcr/raingardens.html>

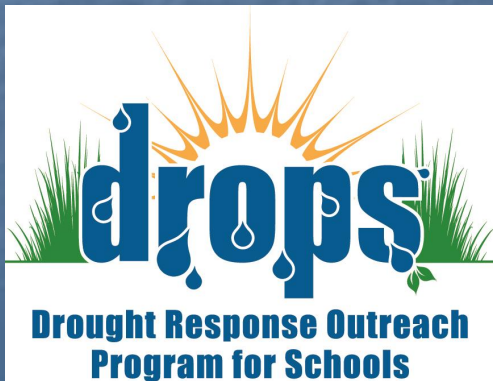
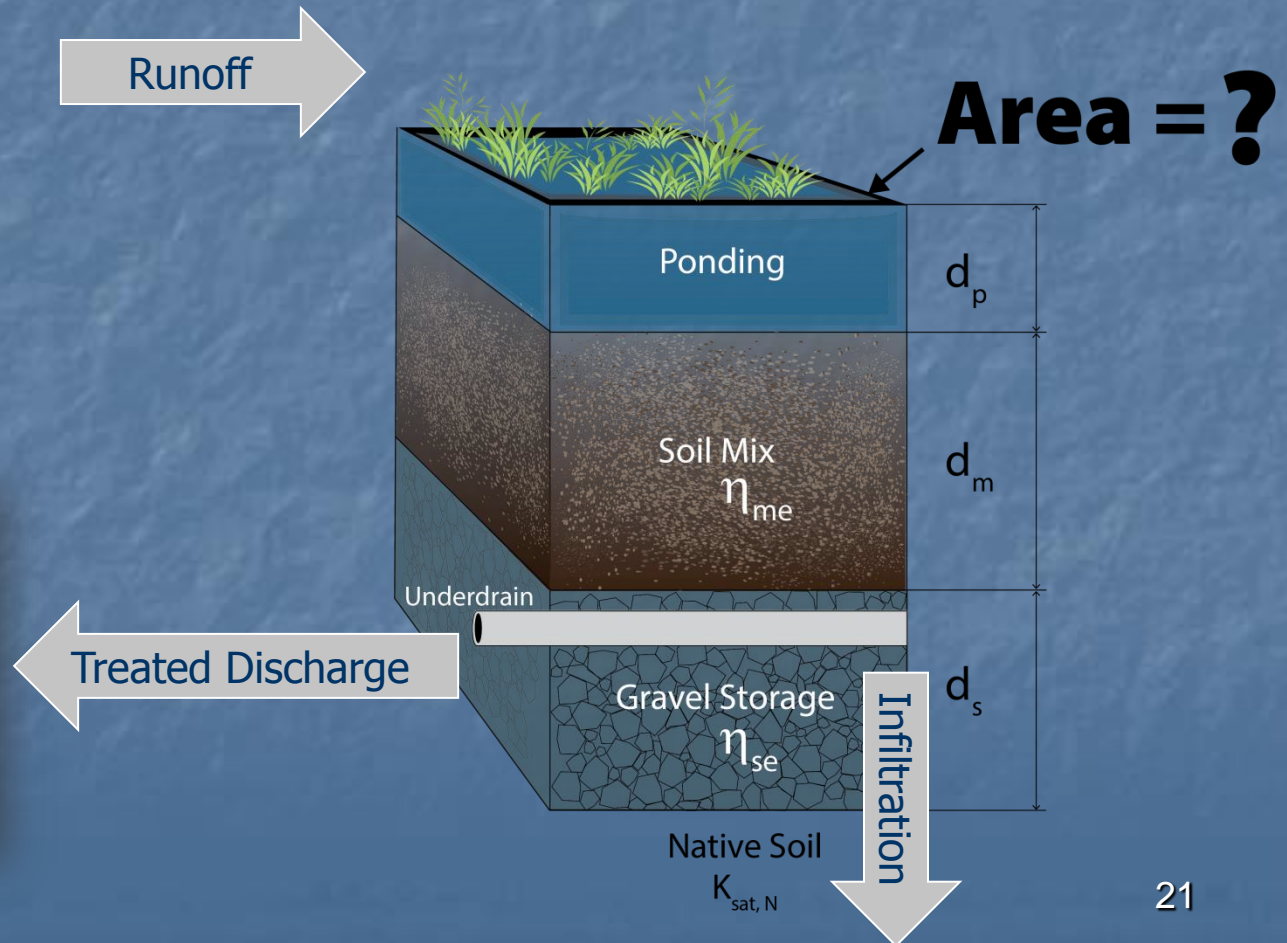
# Project Feasibility

- Existing utilities
- Seasonal high groundwater depth
- Native soils
- Steep Slopes
- Sizing constraints



# Module 2:

## Sizing Your LID Project



# Sizing Your LID Project

- Cumulatively, small storms represent the greatest annual volume and pollutant load.
- LID projects are typically sized to capture/treat the small storms.
- The small storm size is often called the “water quality design storm” and usually equates to the 85th percentile, 24-hr storm event.



# LID Sizing Tool

- The Office of Water Programs at CSU Sacramento have created an online tool to determine the required sizing of common LID project types.
- The tool uses three inputs to determine LID dimensions:
  - design storm depth (precipitation)
  - soil conductivity (infiltration rate)
  - contributing impervious area

# Sizing Steps

- 1. Determine input for tool
- 2. Enter input
- 3. Review the areas provided in the table
- 4. Choose an LID BMP
- 5. Re-evaluate feasibility

(detailed steps are available in pdf)



# Step 1. Determine Tool Input

- Design Storm Depth: 85<sup>th</sup> percentile, 24-hr
  - Use Basin Sizer Tool
- Soil Conductivity
  - Use field data if available, or
  - Obtain from local records, or
  - Use NRCS data (available in LID Tool)
- Contributing Impervious Area
  - Use LID Sizing Tool's measuring option

# Determine Design Storm Depth

The screenshot shows the 'Basin Sizer - Untitled1' application window. The main map displays the state of California with numerous blue square markers representing rain gauges and red lines representing river networks. A text box with an arrow pointing to the 'Zoom' tool in the toolbar reads: 'Use "Zoom" tool to identify school and nearby rain gauges'. The toolbar includes icons for file operations, navigation (pan, zoom, hand), and a yellow lightning bolt icon. The status bar at the bottom left says 'Click on the map to select a site' and the bottom center shows 'Untitled1'. On the right sidebar, the 'Other' tab is selected and circled. Below the tabs is a table for 'Rainfall Stations' with columns for 'Dist (km)', 'Elev (m)', 'Years', and 'Station'. Below the table is a section for the 'California Coastal Commission Method' with the instruction 'Select your site by clicking anywhere in California'. At the bottom right, there is a note: '\*Link to Basin Sizer provided at end of presentation' and a link to the help file: 'See Basin Sizer Help for discussion of output.'

Basin Sizer - Untitled1

File Layers Units Help

Lat 41.992 Lon -121.401

Use "Zoom" tool to identify school and nearby rain gauges

Caltrans Methods CASQA Methods **Other**

Rainfall Stations

| Dist (km) | Elev (m) | Years | Station |
|-----------|----------|-------|---------|
|-----------|----------|-------|---------|

California Coastal Commission Method

Select your site by clicking anywhere in California

Select "Other" tab

\*Link to Basin Sizer provided at end of presentation

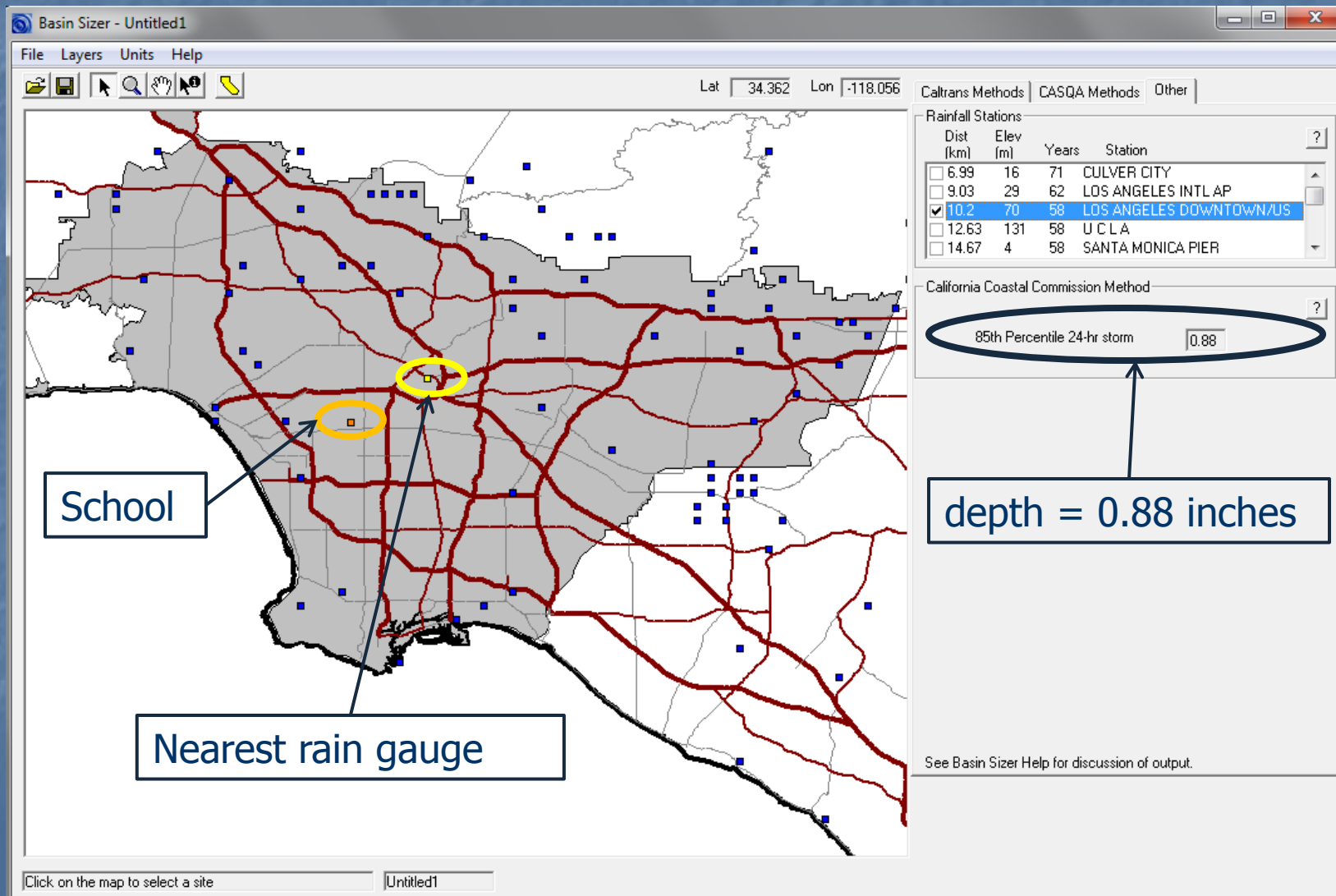
See Basin Sizer Help for discussion of output.

Click on the map to select a site


Untitled1



# Determine Design Storm Depth



# Step 2. Enter Input

 **SACRAMENTO STATE**  
Office of Water Programs

Sac State Home | College of Engineering & Computer Science | Department of Civil Engineering | Office of Water Programs

## California Phase II LID Sizing Tool

Welcome to the California Phase II Low Impact Development (LID) Sizing Tool. This is a web-based tool that assists stormwater practitioners in selecting and sizing LID Best Management Practices (BMPs) that meet the sizing requirements set forth in California's National Pollutant Discharge Elimination System (NPDES) permit. The tool performs calculations for a variety of LID BMP types, performs performance evaluation using the Rational Method, and a Baseline Bioretention or Equivalent Performance Method. The tool also provides information on LID BMP maintenance requirements.

Development of this tool was funded by the California State Water Resources Control Board's (CSWRCB) Population of Stormwater Drainage Program (PSDP).

The tool consists of a website that is linked to a database through a server. The database stores precipitation and evaporation data for multiple geographic locations throughout California, pre-defined parameters for multiple LID BMP types and project soil types, and pre-solved design curves based on SWMM 5 modeling. Over 13,000 SWMM simulations were run to develop these curves. After the user enters project information into the tool's website, the server queries the database, performs calculations, and tabulates the areas required for various LID BMP types.

Use these layers to help you find the data for steps 1 to 3 below the map.

**Step 1**  
☒ Climate Stations

**Step 2**  
☐ Soil Types

**Step 3**  
Find your impervious area  
☐ Measure

Distance (feet): 0  
Area (acres): 0

To ensure the most accurate values zoom in close to your site.

**Other Layers**  
LID Counties

**Climate station**  
BORON

**Step 2 - Input a saturated hydraulic conductivity**  
inches per hour Enter your project site's saturated hydraulic conductivity. If you don't know it, check with your local planning agency or click on the color covering your project site. To see tables of saturated hydraulic conductivity, click on the "Soil Types" box in Step 2 of the Layers sidebar and

**Step 3 - Input the impervious area**  
Acres The CA Phase II NPDES permit requires that when a BMP consists of a 100% impervious area, the BMP must be managed using LID BMPs that meet specific sizing criteria specified in the permit. The tool uses a scenario for your project.

**Assistance in determining tool input**

**Select climate station (rain gauge)**

**Enter soil conductivity (infiltration rate)**

**Enter impervious area**



# Step 3. Review Area Table

| Storm Water Treatment Measures   |  |                              |   |                                |
|--|--|------------------------------|---|--------------------------------|
| LID BMP Types  | Permit Compliant LID BMP Areas (square feet) |                              |   |                                |
|  | Design Storm<br>0.88 inches <sup>1, 3</sup>  | Percent Capture <sup>2</sup> | Baseline<br>Bioretention or<br>Equivalent | Central Coast<br>Simple Method |
| Bioretention Cell - 18" Soil - 12" Gravel Storage                      | <a href="#">325</a>                          |                              |   |                                |
| Bioretention Cell - 18" Soil - 24" Gravel Storage                      | <a href="#">253</a>                          | <a href="#">425</a>          | <a href="#">236</a>                       | <a href="#">637</a>            |
| Bioretention Cell - 18" Soil - 36" Gravel Storage                      | <a href="#">207</a>                          | <a href="#">412</a>          | <a href="#">230</a>                       | <a href="#">409</a>            |
| Bioretention Cell - 24" Soil - 12" Gravel Storage                      | <a href="#">290</a>                          | <a href="#">421</a>          | <a href="#">234</a>                       | <a href="#">1442</a>           |
| Bioretention Cell - 24" Soil - 24" Gravel Storage                      | <a href="#">231</a>                          | <a href="#">407</a>          | <a href="#">228</a>                       | <a href="#">837</a>            |
| Bioretention Cell - 24" Soil - 36" Gravel Storage                      | <a href="#">192</a>                          |                              |   |                                |
| Bioretention Cell - Soil Depth Varies <sup>5</sup> - No Gravel Storage | <a href="#">2370</a>                         |                              |   |                                |
| Infiltration Basin - Vegetated   | <a href="#">4275</a>                         | <a href="#">N/A</a>          | <a href="#">N/A</a>                       | <a href="#">4275</a>           |
| Infiltration Gallery   | <a href="#">935</a>                          | <a href="#">N/A</a>          | <a href="#">2087</a>                      | <a href="#">935</a>            |
| Infiltration Trench  | <a href="#">3050</a>                         | <a href="#">N/A</a>          | <a href="#">N/A</a>                       | <a href="#">3050</a>           |
| Overland Flow no amendment   | <a href="#">N/A</a>                          | <a href="#">N/A</a>          | <a href="#">N/A</a>                       | <a href="#">N/A</a>            |
| Porous Pavement  | <a href="#">3150</a>                         | <a href="#">N/A</a>          | <a href="#">3287</a>                      | <a href="#">3150</a>           |
| Strip, Amended 6"  | <a href="#">5205</a>                         | <a href="#">N/A</a>          | <a href="#">3758</a>                      | <a href="#">5205</a>           |
| Strip, Amended 12"   | <a href="#">1760</a>                         | <a href="#">N/A</a>          | <a href="#">2259</a>                      | <a href="#">1760</a>           |
| Strip, Amended 18"   | <a href="#">1059</a>                         |                              |   |                                |
| Swale, Amended 6" <sup>6</sup>   | <a href="#">5205</a>                         |                              |   |                                |
| Swale, Amended 12" <sup>6</sup>  | <a href="#">1760</a>                         | <a href="#">N/A</a>          | <a href="#">N/A</a>                       | <a href="#">1760</a>           |
| Swale, Amended 18" <sup>6</sup>  | <a href="#">1059</a>                         | <a href="#">N/A</a>          | <a href="#">3535</a>                      | <a href="#">1059</a>           |
| Capture and Use Storage <sup>7</sup>                                   | <a href="#">409 cf</a>                       | <a href="#">1910 cf</a>      | <a href="#">2170 cf</a>                   | <a href="#">409 cf</a>         |

<sup>1</sup> Complies with Phase II permit design storm sizing criteria (Section E.12.e.ii.c.1.a)

Use areas from Design Storm column

LID BMPs (click on an area to see details)

Override default design storm

Select a design storm depth in inches  (The 10th percentile design storm for this location is: 0.96 in)

# Step 4. Select LID BMP

## California Phase II LID Sizing Tool - BMP Details

### Summary

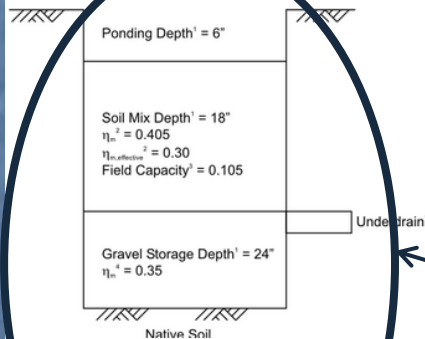
|                                  |   |
|----------------------------------|---|
| Project name                     |   |
| Climate station                  | SANTA BARBARA MUNI AP   |
| Saturated hydraulic conductivity | 0.03 in/hr  |
| Impervious area                  | 6100 square feet  |
| LID area                         | 263 square feet   |
| Total area                       | 8353 square feet  |
| LID BMP                          | Bioretention Cell - 18" Soil - 24" Gravel Storage   |
| Methodology                      | Design Storm<br>User selected design storm is 0.88 inches<br>85th % design storm is 0.95 inches |
| Design storm volume              | 0.892   |
| Design storm volume coefficient  | 0.892   |

Summary of project input and LID BMP

### Description

Bioretention cells are depressed landscapes into which runoff is directed and allowed to pond, filter, and infiltrate. Some bioretention cells modeled by the CA Phase II LID Sizing Tool consist of the design parameters specified in Section E.12.e.i.f.3 of the Phase II permit, including a 6" ponding depth underlain by 18" of bioretention soil mix and 12", 24", or 36" of gravel storage. (The Phase II permit requires a minimum storage depth of 12".) The ponding zone allows for temporary storage of runoff and promotes percolation into the bioretention mix. The runoff is also stored in the mix's structure, as well as being filtered and biotreated. It eventually drains into the gravel layer below which provides a third storage component. A perforated underdrain is located at the top of the gravel storage component to prevent overflow of the system. This system is unlined to allow infiltration into the native soils. The Central Coast Regional Water Quality Control Board (Region 3) has adopted a variation on the permit-prescribed bioretention cell, where the soil mix depth is to be 24", and so the tool includes bioretention cells having the ponding, 24" of soil mix, and 12", 24", or 36" of gravel storage (unlined).

### LID BMP - Bioretention Cell - 18" Soil - 24" Gravel Storage



Narrative description of LID BMP

LID BMP schematic and assumptions

### Depths

| LID Layer      | Depth (inches) |
|----------------|----------------|
| Ponding        | 6              |
| Soil mix       | 18             |
| Gravel storage | 24             |

### Notes

1. SWRCB 2013, LID standard for bioretention, p. 54; CCRWQCB 2013, post-construction requirement for water quality treatment, p. 4.
2. Effective porosity (total porosity - field capacity): VA DCR 2011, 25%; District DOE 2013, 30%; WI DNR 2010, 27%; Prince George 2013, 30%; NC Co-op 2009, 30%; LID Center 2010, 30%. Assume Total porosity = 30% + field capacity.
3. Caltrans 2010, 55% for infiltration trenches; City of Santa Barbara 2008, 30-40% commonly 32%; WI DNR 2010, 33%; NC Co-op 2009, effective porosity 25%. Assume field capacity = 0.
4. USEPA 2010. Field capacity for loam sand = 0.105.

Note: Excavation depths should consider root uplift and expansion within the soil mix layer



# Step 5. Re-evaluate Feasibility

- Do I have enough space?
- Will utilities interfere?
- Is the topography appropriate?
- Do I have enough groundwater clearance?
- Can I commit to the maintenance?



The image shows a screenshot of a web page titled "Links". The page lists various resources under several categories: Construction, Costs, Maintenance, Specifications, Watershed Benefits, and General. A black oval highlights the "Maintenance" section, which contains the link "Urban Design Tools - Maintenance". A white callout box with a black border and a black arrow pointing to the "Maintenance" link contains the text "Tool summary sheet provides links to helpful resources".

**Links**

[EPA Fact Sheet for Bioretention](#)

**Construction**  
[Urban Design Tools - Construction Schedule](#)

**Costs**  
[Urban Design Tools - Costs](#)

**Maintenance**  
[Urban Design Tools - Maintenance](#)

**Specifications**  
[Low Density Residential](#)  
[High Density Residential](#)  
[Commercial/Industrial/Institutional](#)  
[Transportation](#)

**Watershed Benefits**  
[Urban Design Tools - Watershed Benefits](#)

**General**  
[CASPA LID Portal](#)  
[Central Coast LID Initiative](#)  
[EPA Low Impact Development Site](#)  
[Low Impact Development Urban Design Tools Website](#)  
[EPA BMP Fact Sheet for Post-Construction Stormwater Management in New Development and Redevelopment](#)  
[EPA BMP Fact Sheet for On-Lot Treatment](#)  
[Central Coast LID Site Planner \(LID Feasibility Screening Tool - coming soon...\)](#)

Tool summary sheet provides links to helpful resources

# Project Examples

## 59th St. Elementary, Los Angeles

### ■ Tool Input

- Design storm = 0.88 inches
- Soil conductivity = 0.03 in/hr
- Impervious area = see values below

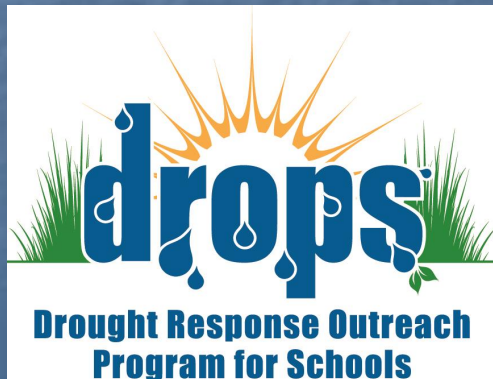
### ■ Three scenarios

- Direct roof runoff to bioretention (6,100 sf)
- Direct roof runoff to cistern (6,100 sf)
- Replace conventional pavement with porous pavement (6,000 sf)



# Module 3:

## Estimating Costs and Water Quality Benefits



Bioretention swale at the LA Zoo

Photo: Ciara Gonzales

# DROPS Project Budget

- Project Administration
- Planning/Design/Engineering/Environmental
- Construction/Implementation
- Monitoring/Performance
- Education/Outreach



# Estimating Design/Construction Costs

- Costs can vary widely
- Information provided in this presentation is drawn from reported values; and, experience from the technical assistance team
- Try to refine costs estimates to the best of your ability
- Take into consideration in-kind labor and expertise

# Estimating Design/Construction Costs

- Often, 10%-30% of construction cost
- Small projects may be similar in effort as medium sized projects
- Degree of complexity, permitting requirements, etc. may increase cost



# Estimating Design/Construction Costs

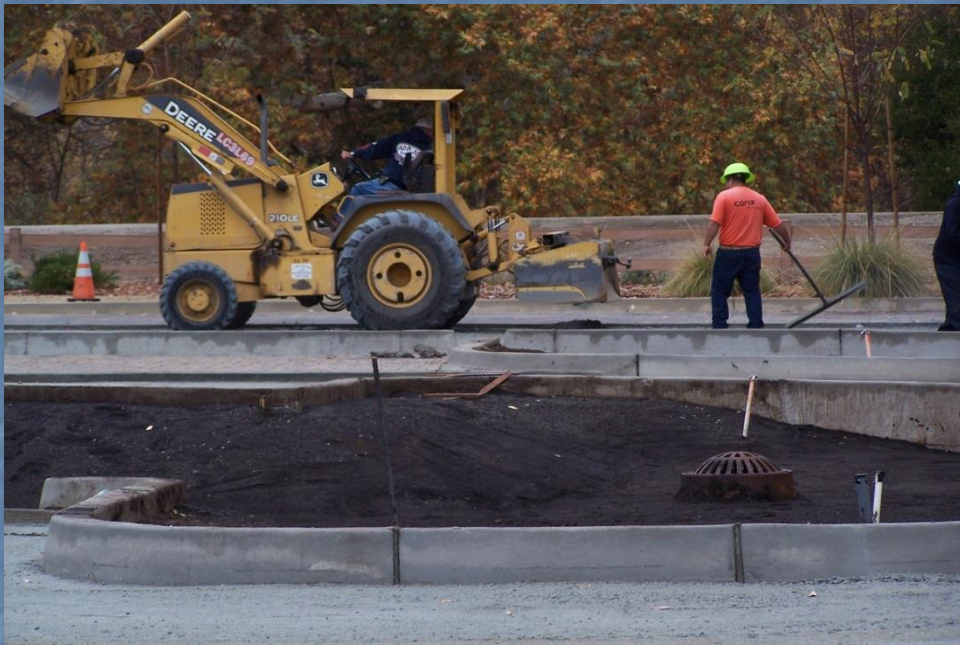
- Construction/Implementation
  - Bioretention
  - Pervious Pavements
  - Cisterns

# Estimating Costs: Bioretention

- Construction/Implementation
  - Ranges from \$5-\$75 / square foot
  - Cost depends on level of complexity
    - Amount of material removal (e.g. concrete)
    - Depth of excavation
    - Materials
    - Grading, routing, pipes, structural stability for surrounding infrastructure, etc.
    - Design elements (e.g., sidewalks, curb, aesthetic)



# Estimating Project Costs: Bioretention



VS.



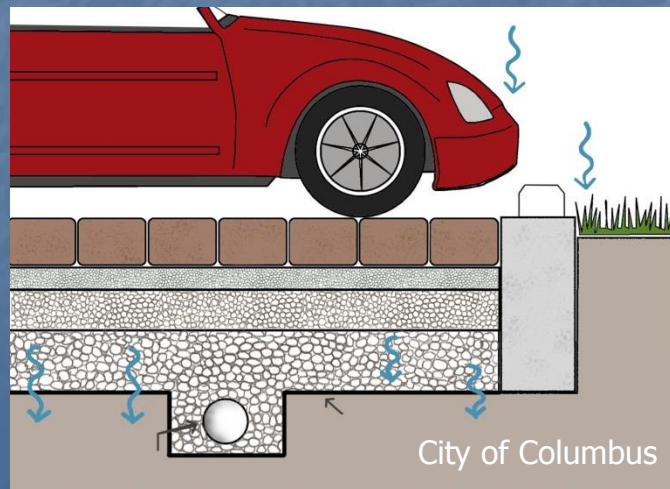
# Estimating Construction Cost: Bioretention

| LID Project Type               | Low Complexity  | Moderate Complexity   | High Complexity   |
|--------------------------------|---|---|---|
| <b>Bioretention</b>            | No impervious removal required (e.g., asphalt, concrete). Little to no hard infrastructure such as curbs, overflow devices, retaining walls, weirs, etc. Example: alteration of an existing landscape area that can be easily retrofit to receive stormwater from a roof downspout disconnection. | May require some removal of impervious material, alteration of an existing overflow, simple curb cuts, etc. Example: addition of a curb-bulb extension bioretention design where existing stormwater routed via curb/gutter can be intercepted at upgradient and exit via curb cut at downgradient. | Requires hard infrastructure such as concrete walls/supports, addition and connection of underground conveyance infrastructure such as underdrains and pipes. Example: A planter box style bioretention that requires concrete sidewalls and underground connection to the existing stormwater drainage system. |
| <b>Construction Cost Range</b> | \$5-\$20 / square foot  | \$20-\$50 / square foot   | \$50-\$75 / square foot   |



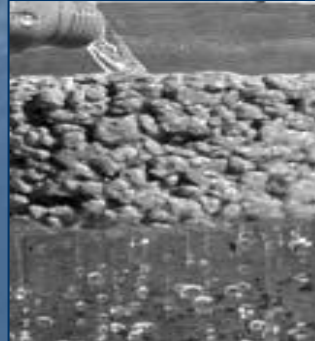
# Estimating Project Costs: Pervious Pavements

- Cost depends on:
  - Type selected
  - Site preparation
  - Incorporation of artistic design



# Estimating Cost: Permeable Pavements

- Typical Installed Costs (placement and materials)
  - Asphalt: 50c to \$1 per square foot.
  - Grass/Gravel Pavers: \$1.50 to \$5.75 square foot.
  - Porous Concrete: \$2.00 to \$6.50 square foot.
  - Interlocking Concrete Paver Blocks: \$5.00 to \$10.00 square foot.





# Estimating Project Costs: Permeable Pavements

- Site preparation, required infrastructure, etc. generally not included in installed cost estimate.



# Estimating Project Costs: Permeable Pavers

- Getting artistic with pavers adds cost



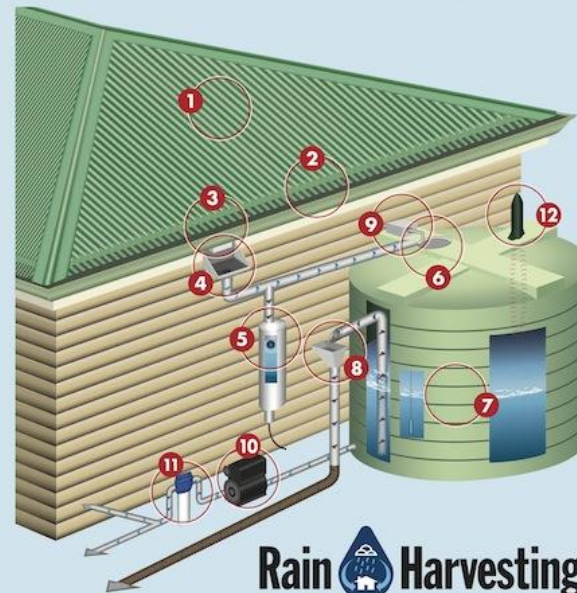


# Estimating Costs: Cisterns

- There may be several components required for the system.
- There are several cistern styles that range in size and material.
- Best to check with a local supplier to get a system estimate.

## How to create the Complete Rain Harvesting System.

1. Check **ROOF SURFACE** is suitable for collecting quality rainwater.
2. Install **GUTTER MESH** to prevent leaves and debris from blocking gutters.
3. Fit **GUTTER OUTLETS** from the underside of the gutter to prevent obstruction of water flow.
4. Fit Leaf Eater or Leaf Beater **RAIN HEADS** (downspout filters) to downspouts to stop gutters blocking. Rain Heads deflect leaves and debris and keep mosquitoes out of pipes that hold water.
5. Install **FIRST FLUSH WATER DIVERTER/S** (sometimes called 'roof washers') to prevent the first flush of most contaminated rainwater from entering the tank. Fit to each downspout that supplies water to the water tank, cistern or rain barrel, or install a large diverter that can handle multiple downspout, beside the water tank or in-ground.
6. Ensure the **TANK SCREEN** is installed at tank/cistern entry point to keep mosquitoes and pests out.
7. Choose a **WATER TANK, CISTERN or RAIN BARREL**. Consider annual rainfall, roof catchment area and water usage when determining its size.
8. Fit **INSECT PROOF SCREENS or FLAP VALVES** to the end of all pipes to the tank/cistern screen and to **TANK/CISTERN OVERFLOW OUTLETS** to keep mosquitoes and pests out and ensure tank is vented properly.
9. Utilize a **TANK/CISTERN 'TOP UP'** system (if required) to automatically 'top up' the tank/cistern with mains water when water levels fall to a designated minimum level.
10. Select a **PUMP SYSTEM** (if required) to distribute water for use inside or outside the home.
11. Fit a purpose designed **RAINWATER FILTER** after the pump to help reduce residual sediment, colour and odour.
12. **WATER LEVEL MONITOR**. Install a level indicator to help monitor your water usage. Wireless systems are most convenient and display a reading inside the home.



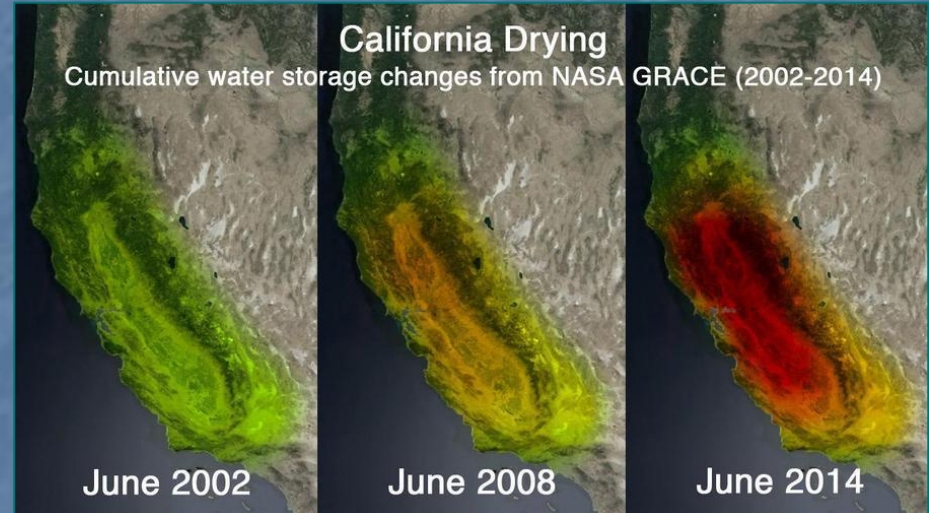
Consider local council requirements and have a qualified professional complete installation where required.

IMPROVES WATER QUALITY • INCREASES CATCHMENT EFFICIENCY • PROTECTS PUMPS AND INTERNAL APPLIANCES • REDUCES TANK/CISTERN MAINTENANCE

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# Estimating Water Quality Benefits





# Estimating Water Quality Benefits

- For LID Projects
  - Estimated volume of stormwater that will be captured (gallons per year), and;
  - If the project will capture stormwater pollutants, what is the approximate amount captured per year.

# Estimating Water Quality Benefits

- Estimated volume of stormwater that will be captured (gallons per year)
  - Capturing storms up to and including the 85<sup>th</sup> percentile, 24-hr storm event is approximately 80% of the average annual volume.
  - We will use this general relationship to estimate average annual volume managed.



# Estimating Average Annual Volume Captured

| Calculation of Average Annual Volume Managed |  |   |                                   |                                     |                                      |                         |  |
|--|--|---|-----------------------------------|-------------------------------------|--------------------------------------|-------------------------|--|
|  | A  | B   | C                                 | D                                   | E                                    | F                       | G  |
|  | Contributing Impervious Area (square feet) | LID facility area receiving direct rainfall (square feet) | Average Annual Precipitation (in) | Average Annual Precipitation (feet) | Annual Volume (cubic feet) [(A+B)*D] | Annual Volume (gallons) | <b>Average Annual Volume Managed (gallons) [0.8 * F]</b> |
| LID Project                                  | 3049                                       | 131   | 20                                | 1.67                                | 5,300                                | 39,643                  | <b>31,714</b>  |

- The contributing impervious area was calculated with the LID Sizing Tool. Example: a roof area contributing runoff a rain garden.
- The LID facility size was determined with the LID Sizing Tool.
- Average annual precipitation can be obtained on-line (e.g., city website).

|                                  |      |
|----------------------------------|------|
| conversion inch to feet          | 0.08 |
| conversion cubic feet to gallons | 7.48 |

# Estimating Water Quality Benefits

- If the project will capture stormwater pollutants, what is the approximate amount captured per year



Kentucky Waterways Alliance



# Estimating Water Quality Benefits

- There are different pollutant types and different concentrations depending on the type of surface being treated (e.g., rooftop, parking lot), so you need to select appropriate values.

# Estimating Water Quality Benefits

## ■ Typical Urban Runoff Pollutant Concentrations for Different Surface Type

| Stormwater Surface Pollutant Loads  |                         |                                  |                                |                                      |                        |                                    |                                    |
|---|-------------------------|----------------------------------|--------------------------------|--------------------------------------|------------------------|------------------------------------|------------------------------------|
| Constituent   | TSS <sup>1</sup> (mg/L) | Total Copper <sup>1</sup> (ug/L) | Total Zinc <sup>1</sup> (ug/L) | Total Phosphorus <sup>1</sup> (ug/L) | Pb <sup>2</sup> (ug/L) | F Coli. <sup>2</sup> (1,000col/ml) | Total Nitrogen <sup>2</sup> (mg/L) |
| Commercial Roof   | 13.5                    | 10.5                             | 268.5                          | 140                                  | 17                     | 1.1                                | 2.1                                |
| Parking Lot   | 51                      | 44                               | 118                            | 145                                  | 28                     | 1.8                                | 1.9                                |
| Walkway <sup>1</sup>  | 25                      | 13                               | 59                             | 110                                  | not reported           | not reported                       | 0                                  |
| Street <sup>3</sup>   | 101                     | 33                               | 135                            | 383                                  | 144                    | *                                  | 2.6                                |
| <sup>1</sup> Average from New York Stormwater Management Design Manual and NRDC Report. |                         |                                  |                                |                                      |                        |                                    |                                    |
| <sup>2</sup> Value from NRDC Report   |                         |                                  |                                |                                      |                        |                                    |                                    |
| <sup>3</sup> Means from Nationwide Urban Runoff Program values for Residential Land use |                         |                                  |                                |                                      |                        |                                    |                                    |

\*fecal coliform concentrations vary widely, ranging between 400-50,000 mpn/100 ml. Lastly, Medium density residential land use was stated as having and EMC concentration of 1.25 mg/l Total Petroleum Hydrocarbons (TPH).



# Estimating Water Quality Benefits

| Calculation of Average Annual Pollutant Reduction |   |   |  |  |                                       |
|---|---|---|--|--|---------------------------------------|
|   | A                                       | B   | C  | D  | E                                     |
|   | Average Annual Volume Managed (gallons) | Pollutant Concentration for Surface Type.<br>Example: Average Copper concentration from Parking Lots (ug/L) | Average Annual Volume Managed (L) (1 gallon equals 3.79 L) | Average Annual Copper Managed (ug) [B*C] | Average Annual Copper Managed (grams) |
| LID Project                                       | 31,714                                  | 44  | 120,196  | 5,288,627                                | 5                                     |

- We again use the relationship that by managing the 85<sup>th</sup> percentile, 24-hr storm event, we are managing approximately 80% of the average annual volume and associated pollutants.
- Need to make sure you are calculating the correct polluted runoff volume. May not be the same volume as calculated for average annual runoff volume managed.

# Resources

- Caltrans Basin Sizer: <http://svctenvims.dot.ca.gov/wqpt/basinsizer.aspx>
- LID Sizing Tool: <http://owp-web1.saclink.csus.edu/LIDTool/Start.aspx>
- [http://www.flowstobay.org/files/greenstreets/GreenStreets\\_booklayout\\_Guidebook.pdf](http://www.flowstobay.org/files/greenstreets/GreenStreets_booklayout_Guidebook.pdf)
- New York State Stormwater Design Manual. "The Simple Method to Calculate Urban Stormwater Loads". Appendix A.
- Natural Resources Defense Council (NRDC). "Investigation of the Feasibility and Benefits of Low Impact Site Design Practices Applied to Meet Various Potential Stormwater Runoff Regulatory Standards." December, 2011.
- Nationwide Urban Runoff Program (US EPA 1983)
- Technical Assistance Team. Contact: [dainglis@ucdavis.edu](mailto:dainglis@ucdavis.edu)